Dup.
PAM 595.373 : (*421)

Suomalaisen Eläin- ja Kasvitieteellisen Seuran Vanamon
Eläintieteellisiä Julkaisuja
Osa 14. N:o 1.
Annales Zoologici Societatis Zoologicæ Botanicæ Fennicæ 'Vanamo'
Tom. 14. N:o 1.

A SURVEY OF THE ONISCOIDEA (ISOPODA TERR.) OF NEWFOUNDLAND

ERNST PALMÉN
(Zoological Institute, Helsinki University)

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Suomenkielinen selostus:
Newfoundlandin maasiiroja koskevia tutkimuksia

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Received 1. X. 1950
Printed 1. II. 1951

Helsinki 1951
Printed by Suomalaisen Kirjallisuuden Seuran Kirjapainon Oy.

1. INTRODUCTION.

The present paper is based on the field investigations carried out during June – August, 1949 by a Finnish-Swedish biological expedition to Newfoundland. This expedition was entirely supported by the Arctic Institute of North America. Grateful acknowledgements are due to this institution for the grants which made the field-work possible. Sincerest thanks are also due to the other members of the expedition (Dr. HARRY KROGERUS, Dr. CARL H. LINDROTH, and Dr. RISTO TUOMIKOSKI) for their assistance in collecting samples of woodlice.

So far very little has been known about the terrestrial Isopod *Crustacea* (*Oniscoidea*) of Newfoundland. The first records are those by STUXBERG (1872, 1875) who recorded two species (*Oniscus vicarius* Stuxb., and *Porcellio scaber* Latr.) from the area in question (see also RICHARDSON 1905). The first-named species later proved to be the common European *Oniscus asellus* L. About fifty years later JOHANSEN (1926) and WALKER (1927) published some new records of these species from Newfoundland (see also VAN NAME 1936, and HATCH 1947). Finally, VAN NAME (op. c.) in his comprehensive treatment of the American terrestrial Isopod *Crustacea* recorded one further species, *Cylisticus convexus* DeG. as probably occurring in Newfoundland (see p. 18). This appears to be all that has been known about the terrestrial Isopods of Newfoundland.

The field work of 1949 resulted in the discovery of 9 additional species of woodlouse from Newfoundland. Three of them (marked with an * in the list below) were not previously recorded from North America either. The species included in our Newfoundland collections are: –

Trichoniscus p. pusillus (Brandt)
**T. provisorius* Racovitza
T. pygmaeus Sars
**Trichoniscoides sarsi* Patience
**Hyloniscus riparius* (C. L. Koch)
Androniscus dentiger Verh.
Haplophthalmus danicus B.-L.
Oniscus asellus L.
Porcellio scaber Latr.
P. dilatatus Brandt
Trachelipus rathkei (Brandt)
Cylisticus convexus De Geer

In this paper, a faunistical survey of the Newfoundland species, as well as some taxonomic, ecological, and zoogeographical data concerning these will be presented.

2. A SURVEY OF THE NEWFOUNDLAND SPECIES.

The collection of 1949 of terrestrial Isopods from Newfoundland has been drawn from a number of localities all over the island. The places visited have

been marked in the map in Fig. 14 (p. 22), which thus provides a basis for the discussion of the distribution of the different species. The locality names and the names of provinces in the lists below are according to the »Ten Mile Map of Newfoundland», published by the Dept. of Natural Resources, St. John's, Newfoundland, in 1941.

Trichoniscus pusillus pusillus (Brandt)

Stuxberg as early as 1875 (p. 49) recorded a species of *Trichoniscus* from N. America under this name. Later a number of other writers recorded additional finds from different parts of N. America (Budde-Lund 1885, p. 244; Underwood 1886, p. 364; Richardson 1900, p. 307, 1901, p. 575, and 1905, p. 694; Racovitza 1908 b, p. 284; Norton 1909, p. 251; Fowler 1912, p. 515; Pratt 1916, p. 381; Arcangeli 1922, p. 4; Johansen 1926, p. 167; Lohmander 1927, p. 1 – 2; Walker 1927, p. 177). Females only of the species in question were known from N. America to the writers mentioned.

Meanwhile, knowledge of the taxonomy of the Old World species of the family *Trichoniscidae* made rapid progress. Verhoeff (1917, et alia), Herold (1923, 1926, 1927, 1929, et alia), and Vandel (1931 a, 1931 b, 1933, 1934) especially published important contributions to the knowledge of the genus *Trichoniscus*. It became evident that the identification of clearly distinct species could only be done through careful examination of the male copulatory appendages (1st and 2nd pleopods) which offer excellent characteristics for the separation of species which are externally almost indistinguishable. It was for this reason that Blake (1931 a) p. 341) proposed the name *T. demivirgo* for the American parthenogenetic species of *Trichoniscus*. There was, in his opinion, no reason to identify the American species, the male of which was unknown, with the European *T. pusillus* Brandt. Since that time, the name *T. demivirgo* has become generally accepted in the American literature (see Procter 1933, p. 247; Pratt 1935, p. 443; Van Name 1936, p. 78, and 1940, p. 138; Dailey & Hatch 1940, p. 252; Hatch 1947, p. 189; Hatchett 1947, p. 52). Recently Hatch (l. c.) pointed out that the solution of the taxonomic problems connected with *T. demivirgo* »must await the finding of males or the discovery of specific characters in the females». Some recent European writers, however, have continued to regard the American populations as specifically identical with the common parthenogenetic European form with a wide geographical range in the Old World (see e. g. Vandel 1945 a, p. 237).

On the basis of the Newfoundland collections of *Trichoniscus* some conclusions concerning the taxonomy and synonymics of the N. American parthenogenetic species can be drawn. The collection of the species in question amounts to 5 285 specimens, about 4 000 of which are adults (either ♀♀ with brood-pouch, or specimens as large or larger than the smallest breeding ♀♀). Among this material three males only were present, belonging to three different populations well separated geographically (see below). Detailed study of these males, the first ones known from

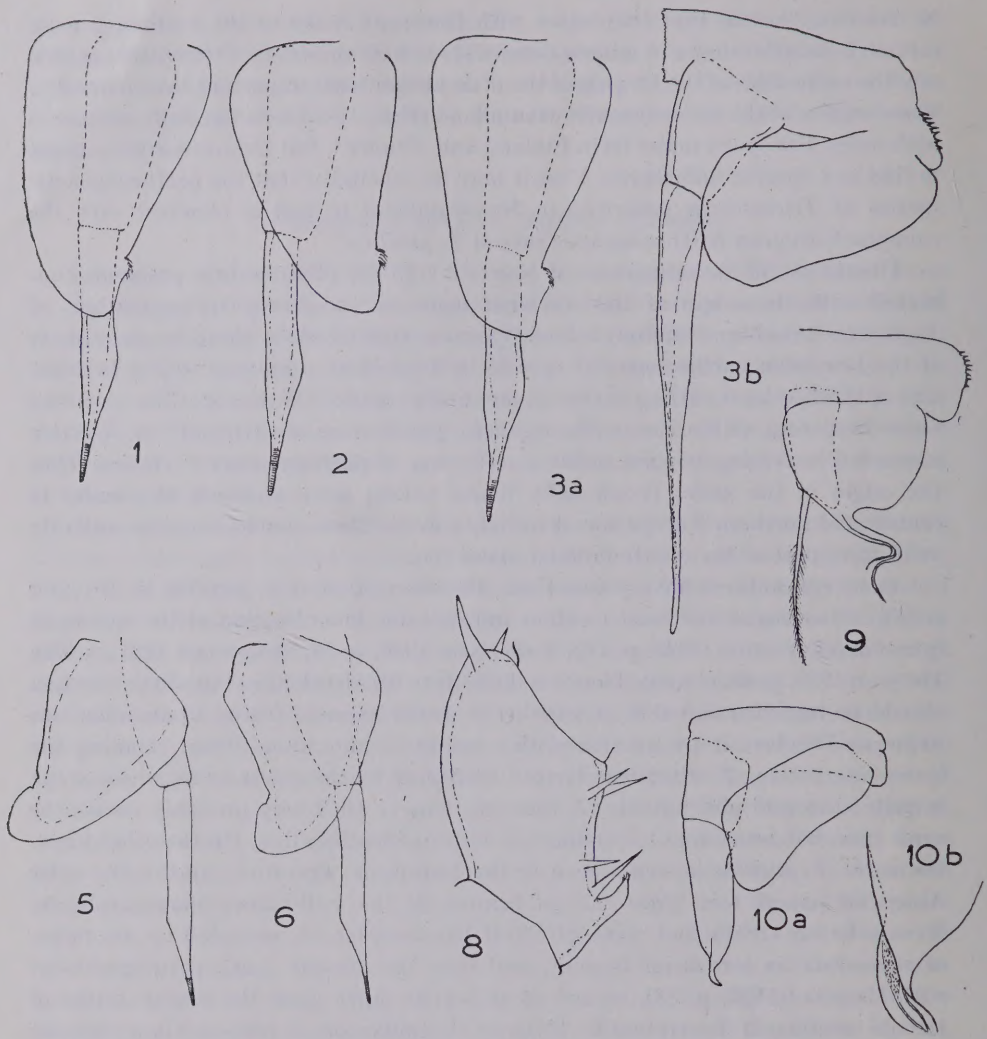
N. America, showed that they agree with European males of the parthenogenetic race of *T. pusillus* down to minute details. As is well-known, in *Trichoniscus* especially the exopodites of the 1st pair of the male pleopods are important taxonomically. These organs of the males from Newfoundland (Figs. 1 – 3) were carefully compared with some European males from Finland and France[1], but the author was unable to find any specific differences. Thus it may be concluded that the parthenogenetic species of *Trichoniscus* occurring in Newfoundland in fact is identical with the common European parthenogenetic race of *T. pusillus*.

Thanks to the investigations of VANDEL (1931 b, 1934) certain problems connected with the origin of the scattered males of the European populations of *T. pusillus* have been definitely solved. VANDEL established the chromosome number of the European parthenogenetic race to be triploid as compared with a bisexual race of this species occurring in certain mountain areas of SW. Europe. The scattered males occurring within the parthenogenetic populations are triploid too; VANDEL succeeded in rearing triploid males as offspring of parthenogenetic females. Thus the origin of the males occasionally found among large numbers of females in central and northern Europe was definitely solved. These conclusions are evidently valid in respect of the Newfoundland males too.

As several authors have pointed out, the description of *T. pusillus* by BRANDT (1833) is too vague and brief to allow indisputable identification of the species in question (cf. VANDEL 1928, p. 173; VAN NAME 1936, p. 78; WÄCHTLER 1937, p. 250; HEROLD 1937, p. 88, et alia). Thus it is difficult to decide whether this old description should be regarded as valid, or whether it would be more fitting to abandon this name and replace it by another with a definite connotation. When choosing the latter alternative, *T. elisabethae* Herold 1923 may be the eldest name whose scope is quite clear and indisputable. *T. rhenanus* Graeve 1914 very probably means the same race, but some doubt is connected with its identification. On the other hand, the name *T. pusillus* is well-known in the European literature, and in the older American papers too. Since the publication of the well-known monographs by BUDDE-LUND (1885) and SARS (1899) it has been largely accepted by a number of specialists on terrestrial Isopods, and thus the present author, in agreement with HEROLD (1937, p. 88), regards it as best to agree upon the interpretation of the old insufficient description by BRANDT. A similar idea is proposed in a previous paper by the present author (PALMÉN 1947, p. 7); however, the preserving of the specific name *pusillus* and the changing of the author's name is in contradiction to the international rules of nomenclature. Thus this proposal must be withdrawn.

There are thus but two alternatives to choose from, namely to preserve the name *T. pusillus* Brandt 1833, which very probably was given to the parthenogenetic

[1] Of the six males employed for comparison, three were collected from wild populations in S. Finland (see PALMÉN 1947, p. 2), the three others are descendants of isolated parthenogenetic females which were kept in cultures by Prof. Dr. A. VANDEL of Toulouse, France, and kindly placed at the authors disposal by him.



Figs. 1 – 3. *Trichoniscus p. pusillus* from Newfoundland. – 1: first pleopod of the ♂ from Cape Broyle, 2: the same of the ♂ from St. John Island, 3: 1st (a) and 2nd (b) pleopod of the ♂ from Norris Arm.

Figs. 5 – 6. First pleopods of ♂♂ of *Trichoniscus provisorius* from Newfoundland. – 5: a male from St. John's, 6: a male from Holyrood.

Figs. 8 – 10. *Trichoniscoides sarsi* from Newfoundland. – 8: merus of the 7th pereiopod of the male, 9: 1st pleopod, 10: 2nd pleopod of the same; in 10 b the tip of the endopodite more enlarged.

race of Central and Northern Europe, or to abandon this name and replace it with *T. elisabethae* Herold 1923 of indisputable connotation. The present author is inclined to choose the first alternative. According to VANDEL (verbal communication) this nomenclature will also be adapted in the hand-book of the terrestrial Isopods of France which he has under preparation.

As regards the parthenogenetic populations of *Trichoniscus* occurring in Newfoundland, the name *T. pusillus* Brandt should thus be accepted. In the case of the populations recorded from the N. American continent, the question is not quite definitely settled yet. However, it appears almost certain that the Newfoundland populations of this species, and those of the American continent in fact belong to the same race, and therefore the present author regards it as very probable that *T. demivirgo* Blake is merely a synonym for *T. pusillus.* (or, alternatively, for *T. elisabethae* Herold). For the definite solution of this synonymy, however, additional males from the N. American continent are needed.

When accepting the name *T. pusillus* for the species in question, one has to consider the parthenogenetic race as the nominate race, *T. pusillus pusillus.* In his hand-book now under preparation, VANDEL (verbal communication) will call the bisexual race of the SW. European mountains *T. pusillus alticola* n. ssp. This is, of course, in full agreement with the rules of nomenclature. The parthenogenetic race, however, is obviously a descendant of the bisexual race, and therefore the present author (PALMÉN 1947, p. 8) proposed that the bisexual race should be regarded as the nominate form and so referred to *T. pusillus pusillus.* This, too, is unfortunately against the rules of nomenclature, and therefore it is necessary to withdraw this suggestion too. The name *T. pusillus vandeli* proposed in the same connection is to be listed under the synonyms of *T. pusillus pusillus* in the above sense. The synonymity is thus as follows: –

Trichoniscus pusillus Brandt 1833
1) race *pusillus* (Brandt 1833), parthenogenetic and triploid.
Syn. *T. elisabethae* Herold 1923
T. pusillus vandeli Palmén 1947
? *T. rhenanus* Graeve 1913
Probably: *T. demivirgo* Blake 1931
2) race *alticola* Vandel 1950 in litt., bisexual and diploid.
Syn. *T. pusillus pusillus* Palmén 1947
T. elisabethae Vandel, nec Herold

Finds from Newfoundland. – No previous records. This species is locally very abundant in the area in question, and has a wide range too (see the map, Fig. 4 on page 7). The finds known to date are: –

Avalon Peninsula: St. John's, 19 ♀; swampy place on the SW slope of Signal Hill, and on moist garden soil within the town. – Waterford Bridge, 9 ♀; moist litter of mixed forest beside meadow-land. – Cape Broyle, 1 ♂ + 111 ♀· among wet litter and mosses on rivulet in *Alnus crispa-Viburnum-Amelanchier*-balsam fir thicket. – Biscay Bay, 13 ♀; on the bottom of brackish water cove, under stones just above the highwater line, and in litter of mixed forest beside a river course.

Fortune Bay and Hermitage: St. Albans, 1 ♀ within the village.

Burgeo – La Poile: Rencontre West, 50 ♀; on open cultivated soil within the village, and in litter of thickets on the bottom of Big Bay. – Hare Bay, 20 ♀; near the mouth of the river, on moist open ground with clear human influence. – Burgeo, 6 ♀· on open wet soil within the village. – Rose Blanche, 39 ♀; around houses and near the harbour of the settlement. – Port aux Basques, 152 ♀; in a graveyard among decaying wet leaves.

St. Georges – Port au Port: South Branch, 646 ♀; very abundant in the wet litter of the river side thickets (chiefly alder) along both the branches of Codroy River, also in localities without any actual human influence. – Stephenville Crossing, 316 ♀; moist or wet litter of alder-willow thickets with scattered *Populus balsamifera*, and rich undergrowth of ferns, *Impatiens* etc.; abundant also under bark of rotten trunks of balsam poplar overlying the soil surface. – Stephenville, mouth of Kippen's River, 191 ♀; thickets on the foot of a gypsum rock, very abundant. – Piccadilly, Port au Port Peninsula, 14 ♀; under stones overlying moist cultivated soil, and among debris of sea-shore just above the highwater mark. – Spruce Brook, 126 ♀; among litter of moist shore thickets along the mouth of Spruce Brook. – Crabbs River, St. Fintans, 68 ♀; among litter of dense, shady hazel thicket surrounding a cold spring.

Humber: Cook's Brook, Curling, 243 ♀; moist litter of river-side thickets (chiefly alder) with luxuriant undergrowth, shady locality. – Corner Brook, 532 ♀; abundant in moist and shady places within the town; also in wet litter of thicket consisting chiefly of *Viburnum edule*, *V. cassinoides*, and balsam fir, and with almost no undergrowth; on swampy shores of small pond, among decaying leaves of *Myrica gale*. – Deer Lake, 9 ♀, among debris on river shore shaded by dense stand of alder and *Acer spicatum*. – Kitty's Brook, 65 ♀; in moist places around the railway station, clear human influence.

Grand Falls: Norris Arm, 1 ♂ + 237 ♀; very abundant in litter of river-side thicket within the village; also on sea-shores above the highwater mark, and around human settlements.

White Bay: Englee, 6 ♀; on grassland moistened by spring water.

St. Barbe: Lomond, Bonne Bay, 795 ♀; very abundant in wet litter of dense aspen stand along a rivu et within the village· also in wet places around human settlements. – Glenburnie, Bonne Bay, 113 ♀; very abundant among mosses and litter of forest with *Acer spicatum* and balsam fir as dominating trees, and undergrowth of *Mitella nuda*, *Impatiens*, *Circaea*, e.g. also in litter of river side thickets. – Woody Point, Bonne Bay, 814 ♀; especially abundant within the village around houses, but also among debris of sea-shores, and among mosses around spring on open pasture-land. – Cow Head, 110 ♀; moist pasture-land around the village, clear human influence. – Port Saunders, 284 ♀; among debris and under small stones on brooklet near the sea-shore, open locality. – Port au Choix, 48 ♀; on debris-covered grassland on seashore, just above the tide line, and in wet to moist places within the village. – St. John Island, 1 ♂ + 245 ♀; abundant among debris on well-protected sea-shore, both in the immediate neighbourhood of the tide line, and further from the shore.

Total number of specimens: 3 ♂ + 5 282 ♀, of the latter 2 719 with brood-pouch.

As appears from the above list of finds, *T. p. pusillus* prefers moist or wet places shaded by a more or less dense layer of bushes or trees. It is locally very abundant in the litter of brook-side thickets, or in the valleys of streams, as well as in the litter of rich woods. On the other hand, it is a common inhabitant of different localities within settlements and towns, where the artificial conditions produced by man secure maintenance of high moisture. As far as the author can see, the data on the habitats of the probably identical *T. demivirgo* agree well with the observations on the occurrence of *T. p. pusillus* in Newfoundland (see Blake 1931, Hatchett 1947, Hatch 1947, e. g.).

Detailed field studies clearly indicate that *T. p. pusillus* has fairly close relations with man in Newfoundland. As a rule it is absent from apparently very favourable localities further away from human settlements, although present in an around the nearest towns and villages. On the other hand, it certainly survives the climatic conditions of the main part of Newfoundland fairly well, as is indicated by its great abundance in numerous localities where no actual human influence is present. In this respect, the occurrence of this species in Newfoundland shows great similarity with its occurrence in NW. Europe (see PALMÉN 1946, p. 14).

Considering the fact that *T. p. pusillus* even at the present time is absent from a number of apparently very favourable localities within its Newfoundland area of distribution, it would seem probable that its occurrence in this area is due to importation by man. Its wide range in this particular area may be at least partly explained by its parthenogenetic reproduction which greatly promotes its dispersal.

Trichoniscus provisorius Racovitza

This European species of *Trichoniscus* first described by RACOVITZA (1908) is evidently very closely related to *T. pusillus*. Whilst the females may be indistinguishable, the males offer good characteristics for separation. The species in question

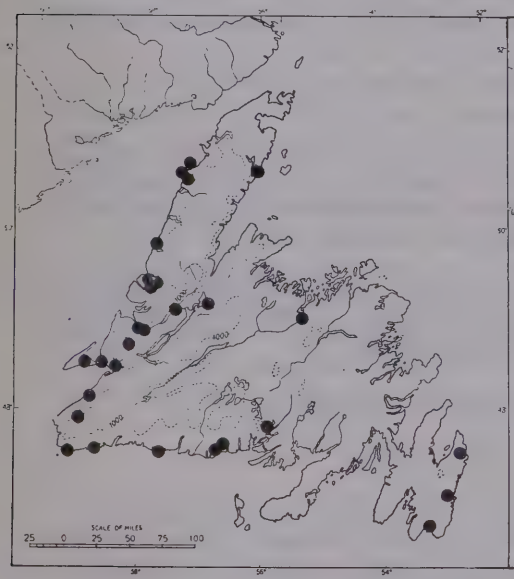


Fig. 4

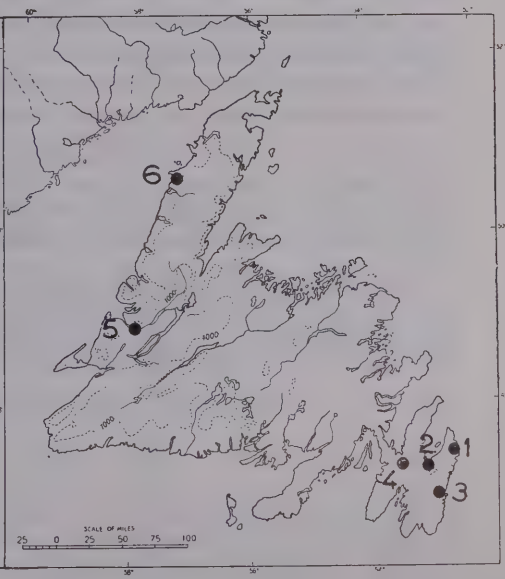


Fig. 7

Fig. 4. Finds of *Trichoniscus p. pusillus* in Newfoundland.
Fig. 7. Finds of *Trichoniscus provisorius* (1, 2), *T. pygmaeus* (1, 6), *Trichoniscoides sarsi* (1), *Hyloniscus riparius* (1), *Haplophthalmus danicus* (1, 2, 3), *Androniscus dentiger* (1), *Porcellio dilatatus* (1, 5), and *Trachelipus rathkei* (1, 2, 4) in Newfoundland.

were confused for about two decades in Europe, until Brian (1926) and, especially Vandel (1931 a) showed the distinguishing characteristics of the exopodite of the male 1st pleopods (see also Palmén 1947, p. 11). As *T. provisorius* has been so far unknown from N. America, some figures drawn from individuals collected in Newfoundland may be presented here (Figs. 5 and 6 on page 4). The individual variation of the exopodite of the 1st male pleopods has been recently treated by the present author on the basis of a collection from Finland (see Palmén 1947).

The distinguishing characteristics are as follows: –

1. The length/breadth ratio of the exopodite of the 1st male pleopod is approximately 1.70 – 1.88 in *T. pusillus* (estimated on the basis of 7 specimens only), whilst it is approximately 1.50 – 1.64 in *T. provisorius*. Thus the exopodite of *T. provisorius* is proportionally broader than in *T. pusillus*.

2. The lateral margin of the same exopodite is almost straight in *T. pusillus*, with merely a small incision at the basal third or fourth, whilst in *T. provisorius* it has a concavity at the basal third, and a second, less conspicuous and more gently curved concavity at the middle.

As regards the interrelations of the forms mentioned, one can but recognize that they must be very closely related. Whether it would be more fitting to consider *T. provisorius* as merely a race of *T. pusillus*, cannot be decided on the basis of the author's collections. Until further notice it seems most suitable to keep them separated specifically, particularly as their geographical range shows great dissimilarity and is so far insufficiently known.

F i n d s f r o m N e w f o u n d l a n d. – No previous records. So far found in two localities (see map in Fig. 7), viz.: –

A v a l o n P e n i s u l a: St. John's, June 4, 1949; 5 ♂♂ + 8 breeding and 1 non-breeding ♀♀ among debris overlying mouldy soil in a garden within the city. – Holyrood, June 10 – 11, 1949; 68 ♂♂ + 121 breeding and 59 non-breeding ♀♀ from shady valley of brook passing through the village, among moist to wet litter overlying mouldy soil.

Some data concerning the body length of the sexes, and the different reproductive stages may be seen in the table below. By body length is meant the distance between the anterior margin of the head, and the tip of the telson.

Body length, mm	♂♂	Breeding ♀♀	Non-breeding ♀♀
1.6	1	–	1
1.9	–	–	1
2.0	3	–	2
2.1	5	–	1
2.2	13	–	2
2.3	11	–	1
2.4	8	1	2
2.5	9	–	4
2.6	9	–	–
2.7	7	1	3

2.8	3	3	3
2.9	–	4	9
3.0	2	12	13
3.1	–	18	2
3.2	1	11	5
3.3	–	13	2
3.4	–	15	1
3.5	–	20	4
3.6	–	13	4
3.7	1	7	1
3.8	–	5	–
3.9	–	2	1
4.0	–	4	–
Total	73	129	60

As is seen from the table, the males are on average about 1 mm smaller than the breeding ♀♀. According to the present data the males always become adult by the time they reach 1.6 mm in length, whilst the smallest breeding females were at least 2.4 – 2.7 mm. The size relations of the sexes mentioned here are well-known for other species of terrestrial Isopods.

As mentioned above, *T. provisorius* has so far not been recorded from N. America. In Europe it is known to occur in France (Racovitza 1908; Vandel 1931 a, and 1933), Northern Italy (Brian 1926), England (Vandel 1933), and Finland (Palmén 1947). In Finland at least, its occurrence is due to human importation, and so far it has been found here only in greenhouses. If *T. noricus* Verhoeff 1917 (see Wächtler 1937) in future proves to belong to this species, as supposed by Vandel (1933, p. 40), its European area extends further towards the east (cf. Kesselyák 1930).

There seems to be hardly any doubt as to the origin of the populations of *T. provisorius* in Newfoundland. Importation by man of this European species can be the only acceptable explanation for these finds. The observations made to date seem to indicate that *T. provisorius* tolerates well the climatic conditions of Newfoundland; the great abundance of this species in the Holyrood locality lends support to this suggestion. As localities apparently favourable for this species are present all over Newfoundland, its further spread in the future appears probable.

Trichoniscus pygmaeus Sars

This species, which is a well-known inhabitant of a large area of Europe, has so far been recorded from N. America only twice. Lohmander (1927, p. 3) was the first to report it from that continent, his finds being made on lily bulbs imported from Sweden to New York (see also Van Name 1936, p. 81). Even in 1936 Van Name (l. c.) recognized that there is no evidence of its having become established in N. America. Later Van Name (1940, p. 139) listed a further find from Garfield Park Conservatory, Chicago, Ill.

The collections of 1949 from Newfoundland include two samples of *T. pygmaeus*, both collected out-of-doors (see map in Fig. 7 on page 7), viz.: –

Avalon Peninsula: St. John's, June 4, 1949· in shady garden within the town, moist humus soil with overlying debris and rotten boards; 3 ♂ + 1 ♀ without brood-pouch, body length of the ♂♂ 1.9 – 2.0 mm, of the ♀ 2.1 mm, all specimens with 3 ocelli.

St. Barbe: Port Saunders, August 5 – 6, 1949; among debris overlying moist garden soil within the village, 4 ♂ + 4 ♀ without brood-pouch + 1 juv.; body length of the ♂♂ 1.9 – 2.2 mm, of the ♀♀ 1.9 – 2.3 mm, all with 3 ocelli.

In *T. pygmaeus* the shape of the exopodite of the 1st pair of male pleopods shows considerable variation, as has been recently pointed out by Palmén (1947, p. 13) on the basis of detailed study of specimens belonging to an isolated greenhouse population of S. Finland. The specimens from Newfoundland fit well within the limits of individual variation described in the paper mentioned. The specific identity of the European populations and those from Newfoundland is thus beyond doubt.

In Europe *T. pygmaeus* belongs to a group of Trichoniscid species which have been largely spread by man. In the case of the N. American finds recorded by Van Name (see above), human importation appears the only possible explanation for the finds in question. The recent finds from Newfoundland, too, have been made under such circumstances that any other explanation seems impossible. In the author's opinion it is to be expected that *T. pygmaeus* will turn out to occur in a number of further localities in N. America; because of its minute size it may very easily be overlooked.

Trichoniscoides sarsi Patience

Representatives of the genus *Trichoniscoides* Sars 1899 have not so far been recorded from N. America. The author's collection from Newfoundland includes a single sample of *T. sarsi* Pat. which is thus to be added to the American fauna: –

Avalon Peninsula: St. John's, August 30, 1949; under deep-lying stones in open locality, just outside the town, clear human influence. 1 ♂ + 5 ♀, one of the latter with brood-pouch, body length of the ♂ 2.9 mm, of the ♀♀ 2.9 – 3.3 mm.

The genus *Trichoniscoides* is an easily separable group of so far entirely European forms. For the delimitation of the genus, as well as the taxonomic characteristics of the 19 species hitherto described, reference may be made to the recent comprehensive study by Vandel (1945 b) including a key to the species so far described.

In this genus an unquestionable identification of the species in general demands study of the male copulatory appendages, and the 7th pair of the male pereiopods. The most important characteristics of *T. sarsi* are shown in Figs. 8 – 10 on page 4, and are as follows: –

The merus of the male 7th pereiopod (Fig. 8) has a hook-like appendage near the basis; this appendage is lacking in the female.

The broad leaf-like exopodite of the male 1st pleopod (Fig. 9) has two lash-like

appendages at the inner corner of the posterior margin. The corresponding endopodite has a short, thick basal joint, and a lash-like distal joint with conspicuous hairs.

The endopodite of the male 2nd pleopod (Fig. 10) has a short, thick basal joint, and a distal joint about twice as long, with a corkscrew-like tip.

These characteristics may in general be sufficient for identification of *T. sarsi*. For further details see the study by VANDEL (op. c.).

In Europe the genus *Trichoniscoides* is a typically Atlantic one, well represented in the west, from the north of the Iberian Peninsula up to England, Scotland, and Ireland, as well as southernmost Scandinavia northwards and the Alps eastwards (cf. VANDEL op. c., p. 161). Certain species on the genus (*T. sarsi*, *T. albidus* B.-L., and, to some extent *T. leydigi* Weber also) show a clear tendency to be secondarily spread by man. These species have repeatedly been found far beyond their supposed original limits of distribution, and then in localities highly influenced by man, or in greenhouses (see LOHMANDER 1923, MEINERTZ 1932, WÄCHTLER 1937, PALMÉN 1947, et alia). The find of *T. sarsi* in Newfoundland is thus anything but surprising. In the present state of knowledge it is uncertain whether the species is established there yet, or whether the find mentioned above is merely a sporadic one. If *T. sarsi* in future turns out to have become established in Newfoundland, its spread to the N. American continent appears very probable.

Androniscus dentiger Verhoeff

Of this originally European species the single American record known so far is that by MEDCOF (1939), who recorded it from a number of greenhouses in London, Ontario, and Toronto (see also VAN NAME 1940, p. 110). To these Canadian records the following one from Newfoundland should be added: –

Avalon Peninsula: St. John's, June 5, 1949; 1 ♂ + 1 ♀ from a greenhouse of a market garden within the city.

For details concerning the taxonomy of this species reference may be made to MEINERTZ (1932) and WÄCHTLER (1937).

Being a representative of an entirely Old World genus, *A. dentiger* without any doubt belongs to the introduced species. As far as appears from the experience of its occurrence in Northern Europe, where it is almost completely restricted to greenhouses (e. g. in Denmark, according to MEINERTZ op. c., and in Finland, according to the author's unpublished observations), it may hardly be able to become established in outdoor localities of Newfoundland. The climatic conditions of this island appear to be too hard for this comparatively southern species.

Hyloniscus riparius (C. L. Koch)

Of the genus *Hyloniscus* with its more than 10 chiefly SE.European species no previous records from America exist. In the author's collections from Newfoundland, two samples of *H. riparius* are included, viz.: –

Avalon Peninsula: St. John's, June 4, 1949; 1 ♂ + 2 ♀ among decaying plant material on moist garden soil within the town; shaded park-like locality. – St. John's, June 5, 1949; 3 ♂ + 5 ♀ in a greenhouse of a market garden within the town.

H. riparius resembles the larger species of *Trichoniscus* externally, but is easily distinguished from these by its having 1 ocellus only, and certain conspicuous sexual characteristics of the male. The merus of the 7th pereiopod of the ♂ has a slightly curved hook ventrally. The 1st and 2nd pairs of pleopods represent a type strictly distinct from *Trichoniscus*, and all other Trichoniscid genera known so far from N. America. For details concerning the taxonomy of this well-known European species reference may be made to the treatment of this genus by Mehely (1929), and to the hand-book of Wächtler (1937), which includes a comprehensive description of *H. riparius*.

As appears from the data above, *H. riparius* without any doubt belongs to the species of *Oniscoidea* which have been introduced into Newfoundland by man and which appear to be completely dependent on man in this area. This species is probably not able to survive the climatic conditions of Newfoundland out-of-doors; at least in N. Europe it is restricted to greenhouses in those latitudes which climatically correspond to those of Newfoundland (see Meinertz 1932, p. 383; Palmén 1947, p. 19).

Haplophthalmus danicus Budde-Lund

According to Van Name (1936, p. 91; 1940, p. 134) and Mulaik (1943) N.American records of this species are known from Indiana, Maryland, New Jersey, Pennsylvania, Kentucky, Tennessee, and Utah in the United States, and from Toronto, Ont., in Canada. To these finds the following from Newfoundland (see map in Fig. 7 on page 7) should be added: –

Avalon Peninsula: St. John's, June 4, 1949; 3 ♂ + 2 ♀ without brood-pouch, under thick layer of moist decaying leaves in a garden within the town, shady place. – Cape Broyle, June 8, 1949: 5 ♂ + 3 ♀ without marsupium, in moist litter of alder – *Amelanchier* – balsam fir thicket beside a rivulet near the village. – Holyrood, June 11, 1949; 3 ♂ + 4 ♀ without marsupium, among litter of shady thicket beside a brook passing through the village, together with *Trichoniscus provisorius*.

Belonging to an originally Old World genus (see Legrand and Vandel 1950, p. 6), *H. danicus* should be included among the introduced species. As is well-known, in Europe this species has also been spread by man far beyond its original range (see Wächtler 1937, p. 262; Legrand & Vandel op. c., p. 9). The observations on the occurrence of *H. danicus* in Newfoundland clearly show the restriction of this species to localities situated in the immediate neighbourhood of human settlements. On the other hand, however, the outdoor finds seem to indicate that *H. danicus* may be able to survive the climatic conditions of the Avalon Peninsula, and thus it may be able to settle there.

Oniscus asellus L.

The genus *Oniscus*, with its three known species, evidently originates in western Europe and certain districts of the African Atlantic coast (see Wächtler 1937, p. 271; Vandel 1945 b, p. 212). One of its species, *O. asellus* L., is an »expansive» species which has become distributed by man far beyond its original range. By means of spread by man it has occupied a wide area of N. America, and is now known from both the eastern and western parts of this continent, from Newfoundland westwards to British Columbia, Washington, and Oregon (cf. Van Name 1936, p. 184; 1942, p. 326; Hatch 1947, p. 195) Hatchett 1947, p. 53).

The first Newfoundland record of *O. asellus* is that of Stuxberg (1872, p. 3; 1875, p. 51; see also Johansen 1926, p. 165) and Walker 1927, p. 177). According to the author's observations, *O. asellus* is a very common and abundant species in certain districts of Newfoundland, but on the other hand is absent or at least extremely scarce in others. The finds known to date are: –

Avalon Peninsula: St. John's, Waterford Bridge, Portugal Cove, Cape Broyle, Renews, Trepassey, Holyrood, Brigus Junction, Whitbourne, Villa Marie, Placentia, Spaniards Bay. – Very common and in places unusually abundant in and around the settlements investigated; it has also occupied a number of localities beyond the immediate neighbourhood of the settlements, and in places it thus occurs very abundantly in litter of woods, and in all kinds of shady, damp places.

Fortune Bay and Hermitage: Gaultois, St. Albans, Pushthrough, Pass Island.

Burgeo–La Poile: Rencontre West, Hare Bay, Burgeo, Grand Bruit, Rose Blanche. – At least in certain villages very abundant around houses under different kind of debris covering the soil surface, but along the coastal line also some distance from the nearest human settlements. Further towards the interior of the island, at least about 1 km from the coast-line, *O. asellus* seems to be absent.

Humber: Kitty's Brook, 1 ♀ with emptied marsupium in a yard at the railway station. – It is a striking fact that in spite of intensive collecting no records except this one are present from the western coast of Newfoundland, from the extreme southwest up to the northernmost part of the Northwestern Peninsula.

Grand Falls: Norris Arm, abundant around houses in the immediate neighbourhood of the railway station.

Total number of specimens investigated: 308 ♂ + 266 ♀ + 71 juv., altogether 645 specimens.

As seen from the above data, the finds of *O. asellus* in Newfoundland are restricted almost completely to the Avalon Peninsula and the southern coastal area. As regards the Burin Peninsula, no records are available as yet. Since *O. asellus* is a species which, if present, hardly may be overlooked, its absence in the western coastal area where intensive collecting has been made (cf. the data on *Porcellio scaber*, p. 16, and the map of the localities of collecting in Fig 14 on p. 22) cannot be only apparent. Thus it is probable that the finds summarized in the map Fig. 11 in fact give an idea of the actual range of this species in Newfoundland. In the south it seems to be well established, whilst scattered finds only are known so far from other parts of the island, and thus from two human settlements along the Newfoundland railway only.

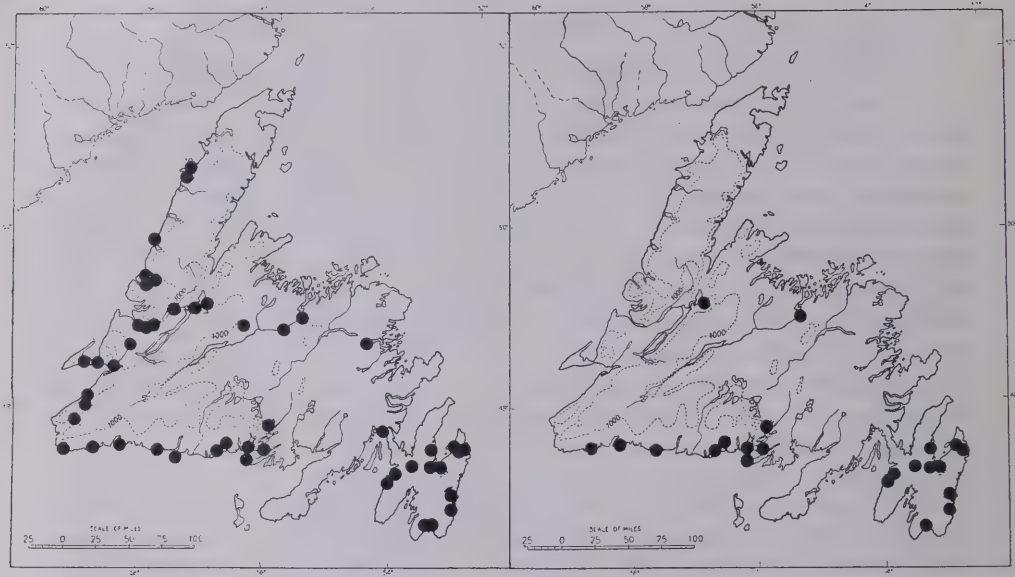


Fig. 12. Fig. 11

Fig. 11. Finds of *Oniscus asellus* in Newfoundland. – Fig. 12. Finds of *Porcellio scaber* in Newfoundland.

The absence or at least the scarcity of *O. asellus* in the villages along the Newfoundland railway may appear somewhat surprising. The two finds from this area now known clearly show that the species has been able to reach the interior of the island by means of spread with railway transport. But on the other hand, its absence or scarcity in this particular area cannot be explained otherwise than by assuming the interior of Newfoundland to be beyond the limits of the area where *O. asellus* is able to maintain itself in outdoor populations permanently. The opportunities for spread by man are in fact excellent.

An interesting fact is that the area of the southern coast of Newfoundland which seems to be permanently colonized by abundant populations of *O. asellus* falls within the limits of the totally ice-free part of this coast land (see the »Ice Atlas of Northern Hemisphere», publ. by the Hydrographic Office, U. S. Navy, as cited by Gutsell 1949, p. 23). This seems to indicate that the presence of ice-free sea-water throughout the winter might be advantageous for this species. Of course the microclimate of the immediate coast-line must be greatly ameliorated by the open sea, and thus the conditions for hibernation of *O. asellus* must be more favourable than along those parts of the coasts which have permanent ice-cover during part of the winter. Thus it seems reasonable to assume that the conditions of hibernation in fact present the factor limiting the local distribution of *O. asellus* in Newfoundland.

As regards the populations of this species on the Avalon Peninsula, one must consider that the dense human populations of this part of Newfoundland provide good chances for this species to find well-protected niches for hibernation. On the other hand, the climate of this southeastern part of Newfoundland is characterized by comparatively low winter temperatures also. The populations of *O. asellus* in the Avalon Peninsula throughout give the impression of being at present well established there, but of course the renewal of the outdoor populations may to a great extent happen through recolonization from populations dependent on man.

Porcellio scaber Latr.

Taxonomy. – Arcangeli (1932, p. 127 – 129), when treating a small collection of this species from the N.American Pacific coast (British Columbia, and California) considered the populations in question subspecifically distinct when compared with certain Old World populations (see also Van Name 1936, p. 229). The form in question was called ssp. *americanus*. Later Hatch (1947, p. 198 – 200), in agreement with this, reported further localities for »at least subtypical specimens» of this form. Moreover, this author replaced the name suggested by Arcangeli by the older *niger* Say, and also considered that the populations of the whole of N. America might belong to the race differing from the European form.

As regards the populations of *P. scaber* occurring in Newfoundland, it appears unquestionable that they cannot be regarded as subspecifically distinct from the European ones. The present author has made a detailed comparison between a number of specimens from the Newfoundland populations, and those of N. Europe, without being able of finding any significant differences. Thus the material from Newfoundland at least cannot become separated from the typical European form of *P. scaber*.

As regards the Pacific coast form which has been reported from other parts of N. America too (see Hatch op. c., p. 199), the present author suspects that the value of the separating characteristics has been somewhat exaggerated. At least the details mentioned by Arcangeli (the stronger pigmentation, the more acute frontal lobe of the head, the larger and more distinct dorsal tubercles, the ischiopodites of the male 7th pereiopods with more or less strongly incurved inner margin, and certain characteristics of the first two pairs of pleopods of both sexes) appear too vague to allow confident separation of the Old and New World forms. Moreover, they show considerable variation according to the age of the specimens. The most definite of the characters of Arcangeli's ssp. *americanus*, the bowing ot the ischiopodite of the male 7th pereiopods, is rather variable (see Hatch 1947, p. 199) and even in specimens from the Pacific coast populations not nearly always so extreme as illustrated by Arcangeli (see also Miller 1936). At any rate it may be necessary to study large populations of the American mainland form before its subspecific distinctness can be regarded as established.

Finds from Newfoundland. – *P. scaber* was reported from Newfoundland already by Stuxberg (1892, p. 4; 1875, p. 59), although without mention of locality (cf. also Hatch 1947, p. 200). Further, Johansen (1926, p. 166) collected it near St. John's, Avalon Peninsula. It is without doubt the commonest species of woodlouse of this island and has a wide range in this area too (see map in Fig. 12 on page 14). The finds known at present are: –

Avalon Peninsula: St. John's, Waterford Bridge, Portugal Cove, Cape Broyle, Renews, Biscay Bay, Trepassey, Holyrood, Brigus Junction, Whitbourne, Villa Marie, Placentia, Spaniards Bay. – Very common all over the Avalon Peninsula in settlements and cities, as well as around them. In the areas with comparatively old human settlements is has occupied a number of localities where the influence of man is less conspicuous, such as woodland, brookside thickets, e.g.

Trinity South: Come by Chance.

Bonavista North: Gambo.

Fortune Bay and Hermitage: Gaultois, St. Albans, Pushthrough, Pass Island.

Burgeo – La Poile: Rencontre West, Hare Bay, Ramea Island, Burgeo, Grand Bruit, Rose Blanche, Port aux Basques. – Very common in all settlements visited, and in places apparently well established in localities without actual human influence, especially riverside thickets, and litter of rich woodland.

St. Georges–Port au Port: South Branch, Codroy Pond, St. Davids, Stephenville Crossing, Kippen's River (W of Stephenville), Piccadilly (Port au Port Peninsula), Spruce Brook. – Very common around settlements, but well established in localities without actual human influence too.

Humber: Curling, Corner Brook, Steady Brook, Deer Lake Howley, Kitty's Brook.

Grand Falls: Millertown Junction, Grand Falls, Norris Arm.

St. Barbe: Lomond, Glenburnie, and Woody Point (all in the Bonne Bay area); Cow Head, Port Saunders, Eddies Cove W. – Absent in Daniels Harbour, Port au Choix, and to the north of Eddies Cove W.

Number of specimens investigated: 642 ♂ + 846 ♀ + 46 juv.

P. scaber has a wide range in Newfoundland. The actual area occupied by this species clearly exceeds that of *Oniscus asellus*. *P. scaber* thus seems to be less sensitive to the rather raw climate of Newfoundland than *O. asellus*. In this respect, the data obtained from Newfoundland agree well with corresponding data from the northern periphery of these species in the Old World, e. g. Fennoscandia (see Palmén 1946, p. 18 and 24) and Iceland (Lohmander 1928, Meinertz 1938). No such restriction to the southern coast of Newfoundland as in *O. asellus* is present in *P. scaber*, which has followed human settlement throughout the island with the exception of part of the Northwestern Peninsula. Thus the range of *P. scaber* seems to be almost the same as that of *Trichoniscus p. pusillus*.

It may be regarded as certain that the occurrence of *P. scaber* in Newfoundland is due introduction by man. As pointed out above, the populations of this species in Newfoundland cannot be separated from the European ones morphologically. Therefore introduction from Europe must be regarded as certain for this species. Even at present the antropochoric character of the Newfoundland populations of *P. scaber* is obvious; in the main part of this island it occurs chiefly in settlements and towns, and in their immediate surroundings. Only in the Avalon Peninsula

may *P. scaber* be found fairly regularly also in localities with inconspicuous human influence, whilst in other parts of the island it still follows human settlement very closely.

The habitats of *P. scaber* in Newfoundland are variable. As well as in conditions created by man it is a common inhabitant of sea-shores with overlying wrack and other debris in a number of places. It is frequently to be found along rivers and in river-side thickets also, and in litter of different kinds of woods too. The eurytopic character of *P. scaber* known from other districts of N. America thus holds true in respect of Newfoundland also (see Hatchett 1947, p. 53; Hatch 1947, p. 199). The great abundance of this species in Newfoundland is conspicuous, and may to a great extent be caused by the comparatively high atmospheric humidity, as well as by the correspondingly high moisture of the soil, even in open places exposed to the sun. The unusually great abundance of *P. scaber* is especially conspicuous in the southern coastal area of Newfoundland where the rate of precipitation is high and fog is frequent. At any rate this species is well-established in Newfoundland, and may at present be able to exist there indepently of man's influence.

Porcellio dilatatus Brandt

Of this species there are so far American records from the west only, viz.: California (Miller 1936, 1938; under the name of *P. spinicornis* ssp. *occidentalis*), Arizona (Van Name 1940, p. 118), British Columbia, Washington, Oregon, and Idaho (Hatch 1947, p. 201). According to Hatch (l. c.) this species seems to be a fairly common inhabitant of the greenhouses of the Pacific Northwest, where it occurs out-of-doors only occasionally. More southwardly, in the San Francisco Bay area it lives out-of-doors too. From the western parts of N. America, as well as from Canada, no records have so far been made.

Two finds of *P. dilatatus* are now known from Newfoundland (see map in Fig. 7 on page 7), viz.: –

A v a l o n P e n i n s u l a: St. John's, 2 ♂ (11 and 13 mm) + 1 ♀ (10 mm) without brood-pouch, in a greenhouse within the town.

H u m b e r: Corner Brook, 1 ♂ (7 mm) + 1 ♀ (11 mm) with brood-pouch; open yard near the railway station of the town.

As *P. dilatatus* is one of the commonest European Porcellionids, there appears to be no doubt as to its having been introduced from Europe to Newfoundland. Being in N. Europe, as well as in western N. America, almost completely restricted to greenhouses or their immediate surroundings (see Meinertz 1932, Palmén 1946) *P. dilatatus* probably cannot become established in Newfoundland out-of-doors. But on the other hand it may be able to survive in towns and settlements where the severe winters can be avoided in man-made conditions.

Trachelipus rathkei (Brandt)[1]

According to Van Name (1936, p. 264) *T. rathkei* is widely distributed in the Eastern United States, and Walker (1927, p. 177 – 178) considers it to be the commonest species of woodlouse of eastern Canada, which greatly outnumbers the other specimens taken together. So far no finds of *T. rathkei* have been reported from Newfoundland, and the collections of 1949 include only three samples of this species, viz.: –

Avalon Peninsula: St. John's, 2 ♂ (9 and 10 mm) and 2 ♀ (10 and 11 mm) without marsupium; sunny slope of Signal Hill, under stones and debris on gravelly soil, together with *Porcellio scaber* and *Oniscus asellus*. – Holyrood, 3 ♂ (9, 10 and 11 mm) + 1 juv.; open pasture-land within the settlement, under boards and debris overlying the soil. – Whitbourne, 4 ♂ (5, 6, 8 and 9 mm); dumping-ground near the railway station.

The conspicuous scarcity of *T. rathkei* in Newfoundland appears quite unexpected. This scarcity cannot, however, be only apparent, since numerous localities where according to experience from other areas this species could have been able to live were carefully investigated, and proved to be inhabited by abundant populations of *Porcellio scaber* or this species and *Oniscus asellus* only. The restriction of *T. rathkei* to the Avalon Peninsula (see map in Fig. 7 on page 7) is difficult to explain, since according to Johansen (1929, p. 106) it is present in Nova Scotia including Cape Breton Island, as well as in the Prince Edward Islands just SW of Newfoundland. The present author has not so far found any reasonable explanation for the absence of *T. rathkei* in W. Newfoundland, apart from that of chance.

T. rathkei belongs to the »lignée asiatique ou quinquetrachéate» of the Porcellionids (Vandel 1945 a, p. 243), thus being of doubtless Old World origin. There seems to be hardly any doubt as to the origin of the N. American populations, the only reasonable explanation for the colonization of N. America by this species being introduction by man in comparatively recent times, as suggested by some previous writers (see Van Name 1936, p. 179; Walker 1927, p. 179, et alia).

Along its northern periphery in Europe *T. rathkei* survives well the climatic conditions of Southern and Central Finland and Scandinavia out-of-doors (see Palmén 1946, p. 26). Therefore it may be able to survive the similar climatic conditions of Newfoundland without difficulties, and thus its further spread in the area in question seems probable.

Cylisticus convexus (De Geer)

No certain records from Newfoundland are so far known for *C. convexus*. According to Van Name (1936, p. 261), however, the American Museum of Natural History possesses a specimen labelled »St. John's, Labrador», which in his opinion

[1] Recently Holthuis (1949, p. 183) has employed this generic name instead of *Tracheoniscus* Verh. The present author endorses his opinion as to the validity of Budde-Lund's name.

probably refers to Newfoundland (see also HATCH 1947, p. 203). As the occurrence of *C. convexus* in Newfoundland has now been confirmed by recent finds, the interpretation of VAN NAME is very probably correct. – *C. convexus* is the third commonest of the larger woodlice of Newfoundland, being represented in the 1949 collections by the following samples (see map in Fig. 13): –

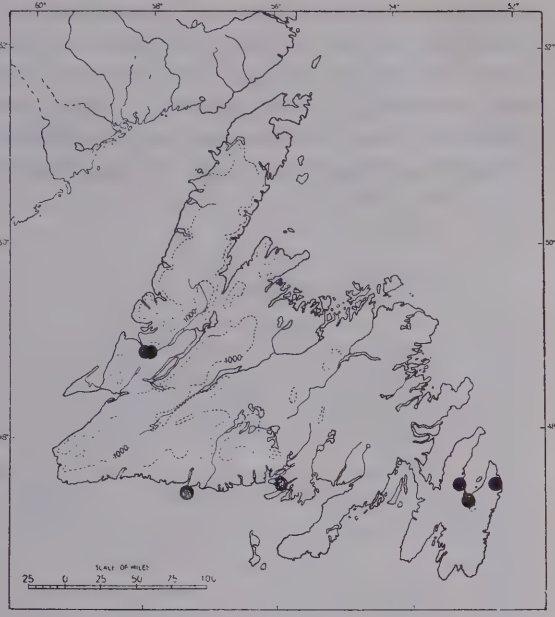


Fig. 13. Finds of *Cylisticus convexus* in Newfoundland.

Avalon Peninsula: St. John's, 1 ♂ + 1 ♀ without brood-pouch; among debris in a yard. – St. John's, Signal Hill, 2 samples under stones on moist grassy patch on the hill slope, the one in June 3, 1949, with 12 ♂ + 17 ♀ without brood-pouch, the other in August 28, 1949, with 25 breeding ♀. – Spaniards Bay, 1 ♀ without brood-pouch under stone on open soil close to the settlement. – Holyrood, 1 juv. on open pasture-land with loose stones overlying the soil.

Fortune Bay and Hermitage: Gaultois, 6 ♂ + 1 ♀ with brood-pouch + 1 juv.; on hard grassland near the settlement, obvious human influence.

Burgeo–La Poile: Ramea Island, 1 ♀; open ground by the harbour.

Humber: Curling, 5 breeding ♀ under stones and litter at the base of the bush vegetation bordering the shores of Cook's Brook. – Corner Brook, 2 ♂ on dumping-ground within the town.

Total number of specimens: 21 ♂ + 51 ♀ + 2 juv., altogether 74 specimens.

The finds of *C. convexus* in Newfoundland are without exception located within or in the immediate surroundings of settlements, or cities. Thus this species gives the impression of having been introduced by man into this area. The present author has without any success searched for it in numerous apparently favourable localities further away from human settlements, and thus the anthropochoric character of the Newfoundland populations of this species appears established. For eastern Canada the same was suggested by WALKER (1927, p. 174), and, in respect of the whole of N. America by HATCH (1947, p. 203). On the other hand, VAN NAME (1936, p. 261), when dealing with the N.American finds of *C. convexus*, states it to be widely distributed in the eastern parts of N.America »where it may be indigenous as it occurs in woods and other places more or less remote from human habitations as well as about the latter». Recently HATCHETT (1947, p. 55), when dealing with the occurrence of *C. convexus* in Michigan, has pointed out that it has never been collected from the central parts of woodlands, unless roads or other man-made

clearings were present. As the genus *Cylisticus* is originally SE. European (see Wächtler 1937, p. 297), *C. convexus*, in the present author's opinion, can hardly be anything but introduced to N. America in comparatively recent times by European colonists or by the commerce. Its conspicuous adaptability to different environments may be the reason for its apparently indigenous occurrence in several outdoor localities in N. America, as is known for certain areas of N. Europe too (cf. Palmén 1946, p. 27).

3. ZOOGEOGRAPHICAL AND ECOLOGICAL REMARKS.

As appears from the faunistical survey above, all species of *Oniscoidea* so far known from Newfoundland are more or less widely distributed in the Old World, especially in the comparatively well-known western European area.

As a matter of fact this entirely European composition of the *Oniscoidea* of Newfoundland is not surprising. The important role of Old World species in the N. American fauna of Oniscoids is a well-known fact to specialists of this group. Recently Vandel (1949, p. 10), in his treatment of the »north-atlantic» element of woodlice, regards it as probable that all species extending beyond lat. 35° N in N. America have in fact recently been introduced by man. According to Hatch (1947) and Van Name (1936, 1940, 1942), altogether 67 species of terrestrial Isopods have so far been recorded from N. America north of Mexico. In the present paper, three further European species were listed, and thus the number of species known to date from this part of N. America is 70. Of these species, a number are restricted to the warm-temperate zones of the United States. Twenty-seven species only are at present known from the eastern and northeastern parts of N. America, excluding the warm-temperate areas just north of the Gulf of Mexico and Florida, viz.: –

Ligia exotica Roux
Ligidium longicaudatum Stoller
Trichoniscus p. pusillus (Brandt)
T. provisorius Racovitza
T. pygmaeus Sars
Miktoniscus halophilus (Blake)
M. medcofi Van Name
Cordioniscus stebbingi (Pat.)
Androniscus dentiger Verh.
Trichoniscoides sarsi Pat.
Hyloniscus riparius (C. L. Koch)
Haplophthalmus danicus B.-L.
Scyphacella arenicola Smith
Armadilloniscus ellipticus (Harger)
Philoscia vittata Say
P. culebrae Moore
Oniscus asellus L.
Platyarthrus hoffmanseggii Brandt
Porcellio scaber Latr.
P. dilatatus Brandt
P. laevis Latr.
P. spinicornis Say
Porcellionides pruinosus Brandt
Trachelipus rathkei Brandt
Cylisticus convexus (DeG.)
Armadillidium vulgare Latr.
A. nasatum B.-L.

Only seven out of these 27 species are endemic in N. America, viz.: *Ligidium longicaudatum*, *Miktoniscus halophilus*, *M. medcofi*, *Scyphacella arenicola*, *Armadilloniscus ellipticus*, *Philoscia culebrae*, and according to Hatch (1947, p. 193),

probably *Philoscia vittata* too. The relative importance of Old World species thus definitely increases towards the north.

Against this background, the entirely European specific composition of the Newfoundland fauna of Oniscoids is anything but surprising. But on the other hand, some of the endemic American littoral species known from certain coastal localities on the east coast of the United States (New Jersey to Massachusetts) might perhaps have been expected in the Newfoundland area too. The species in question (*Armadilloniscus ellipticus*, *Scyphacella arenicola*, *Miktoniscus halophilus*, and *Philoscia vittata*) are known to be inhabitants of salt marshes, or sandy or stony seashores (see VERRILL & SMITH 1873; BLAKE 1930, 1931 a, 1931 b). Localities of this kind were carefully investigated in Newfoundland, but *Porcellio scaber*, and in some districts *Oniscus asellus* too, were found to be the only Oniscoids of the localities in question. Therefore it is almost certain that the northern boundary for the range of the endemic American species just mentioned does not reach even the south of Newfoundland.

The same holds true, too, for *Ligidium longicaudatum*, an inland species which has been recorded from some localities in Ontario (WALKER 1927, p. 176), these localities being the only Canadian records for this species typical of wet spots of woods.

On the basis of the above, the present author is inclined to believe that the Oniscoid fauna of Newfoundland does not, in fact, include any endemic American species.

Those species of woodlouse which are common to N.America and the Old World are generally believed to be comparatively recent colonists from Europe. This opinion may be justified by two facts especially, viz.: 1) the species common to both continents are generally restricted in N. America to man-made outdoor conditions, towns, settlements, and their immediate surroundings, or even to greenhouses, and thus even at the present time they are to a more or less conspicuous degree dependent on man: 2) the species in question belong to phylogenetic groups or lines of evolution, of doubtless Old World origin. Only few species of these Old World groups have been able to colonize N.America see VANDEL 1945 a, p. 265). Both American and European specialists on terrestrial Isopods seem to agree on this explanation for the conspicuously European character of the fauna of N.American Oniscoids, which includes several species now well established and more or less widely distributed in N.America (see VAN NAME 1936, p. 37; WALKER 1927, p. 174; HATCH 1947, p. 177 – 178; VANDEL 1949, p. 10, et alia).

The historical data on the colonization of N.America by Old World Oniscoids are unfortunately extremely scarce, and thus they do not allow conclusions as to the time of arrival of the different species. However, it is certain that *Porcellio scaber*, *P. spinicornis*, *Oniscus asellus*, and *Armadillidium vulgare* were already well established there before 1818, that is to say at the time when the first survey of N.American Oniscoids by SAY was published. During the 19th century, almost all those European Oniscoids which are now common in N.America were recorded

from this area for the first time. In the 20th century, some important additions have been made, viz.: *Trichoniscus pygmaeus* (first record by Lohmander 1927), *T. provisorius* (recorded here for the first time), *Androniscus dentiger* (first record by Medcof 1939), *Hyloniscus riparius* (recorded here for the first time), *Cordioniscus stebbingi* (first record by Blake 1931 b), *Platyarthrus hoffmanseggii* (first record by Van Name 1940), and *Porcellio dilatatus* (first record by Miller 1936, under the name *P. spinicornis* ssp. *occidentalis*; cf. Van Name 1940, and Hatch 1947). Since these species, one of which is now well established on the Pacific coast of N. America (*P. dilatatus*), were not recorded by previous writers on terrestrial Isopods of N.America, there is reason to believe that they may in fact be fairly recent colonists from the Old World. In the present author's opinion it is of great zoogeographical interest to make continuous observation on the range changes of the European species in N.America, especially of those which are at present restricted to more or less small areas. The results obtained will certainly serve as a good basis for the elucidation of the influence of man on the N.American fauna as a whole. The same, of course, holds true for the European elements of other groups also. The study of animals spread by man in recent times should not be neglected even though it does not allow of conclusions which can be extended to cover longer periods of the faunal history.

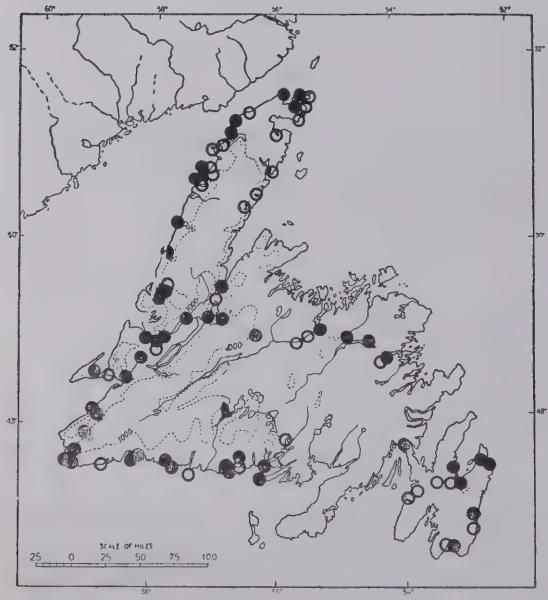


Fig. 14. Places visited during the summer of 1949. Open circles: more or less brief collecting only.

As regards the introduction of Old World organisms to N. America, Newfoundland without doubt is one of the most favoured districts. Continuous communications between this island and a number of Old World harbours have now existed, on a more or less intensive scale, for about 450 years. Within Newfoundland the Avalon Peninsula with its comparatively large St. John's harbour could be expected to be inhabited by the comparatively richest European element. A study of the distribution of the terrestrial Isopods within Newfoundland[1] clearly confirms this suggestion. It may not be merely a chance that all species of woodlouse now known from

[1] The adjoining map in fig. 14 provides a basis for the preliminary discussion of the distribution of the different species.

this island were found on the Avalon Peninsula. Moreover, five out of the 12 species so far known from Newfoundland were found only on the Avalon Peninsula, viz.: *Trichoniscus provisorius*, *Trichoniscoides sarsi*, *Androniscus dentiger*, *Hyloniscus riparius*, and *Trachelipus rathkei*.

Of these species, the restriction of *T. rathkei* to the Avalon Peninsula cannot be due to factors of survival; this may be justified by the fact that *Trachelipus rathkei* is known to be one of the commonest species of Nova Scotia (incl. Cape Breton Island) and Prince Edward Islands, i. e. just east of Newfoundland. Therefore the absence of this species in the west of Newfoundland cannot be explained without supposing man to be responsible to the minor features of the present-day distribution. The good communications between Europe and the Avalon Peninsula thus seem to be the reason for the comparatively rich fauna of terrestrial Isopods of this part of Newfoundland.

For the present the author regards the following species of woodlouse as being thoroughly established in Newfoundland: –

Trichoniscus p. pusillus
T. provisorius
Oniscus asellus
Porcellio scaber
Cylisticus convexus

These species, according to the field observations, have at least in certain districts of the island occupied localities where they are very probably able to survive even without frequent renewal of the outdoor populations from those of artificial habitats. To a certain degree, *Oniscus asellus* appears to have reached its limits of survival; as pointed out above (p. 14), its complete absence in the western coastal area of Newfoundland cannot be caused by factors of spread, but probably by the conditions of hibernation. On the Avalon Peninsula and on the southern coast, with its high rate of precipitation, and its ice-free coastal waters, the outdoor populations of *O. asellus* seems to be more or less independent of man. The scattered finds along the Newfoundland railway are obviously due to the very favourable conditions for spread brought about by the regular railway communications, and they almost certainly lie beyond the limit of the survival area of this species.

It is rather interesting to compare the geographical range of the Newfoundland woodlice with corresponding data from northern Europe. Comparatively severe winters and tolerable summers are common to both these areas. Of the species common to both areas, *Trichoniscus pusillus*, *Oniscus asellus*, *Porcellio scaber*, *Trachelipus rathkei* and *Cylisticus convexus* are well established in Fennoscandia (see Sars 1899; Palmén 1946, 1947), *P. scaber* being the only species which has hitherto been recorded from localities beyond the Arctic circle. In Newfoundland this species gives the impression of being able to maintain itself in the greater part of this island even without the assistance of man. However, it is clearly less abundant towards the north of the island, as indicated by the absence of finds from a number of localities along the Northwestern Peninsula. Finds from artificial habitats, of course, are to be expected from much more northern districts, as is

indicated by the two finds from the Square Islands and Hopedale on the east coast of Labrador (see JOHANSEN 1926 a, p. 40; 1926 b, p. 166).

Oniscus asellus and *Cylisticus convexus* which, in Newfoundland, are more or less restricted to the southern part of the island, show similar relations in NW.Europe too. In S. Finland *O. asellus* is restricted to the south coast where, however, it probably is to a great extent dependent on man. The same holds true for *C. convexus* also (PALMÉN 1946, p. 19 and 27).

Being represented in Newfoundland by the parthenogenetic race only, *Trichoniscus pusillus* of course has the greatest chances of all the species of woodlouse of becoming widely distributed. This may be one of the reasons for the fairly wide range of this species in Newfoundland. On the other hand, the high rate of precipitation, and in certain districts the frequent occurrence of fog may also be favourable for this extremely hygrophilous species.

Finally, some remarks concerning the present state of knowledge of the Newfoundland Oniscoids should be made. The number of species occurring in this island may perhaps in future be increased by further European immigrants that are already known from other parts of N. America, viz.: *Porcellio spinicornis*, *Armadillidium vulgare*, and *A. nasatum*. *P. spinicornis* is now well-established in N. America, where it occurs northwardly to certain districts of Canada (see VAN NAME 1936; JOHANSEN 1926 b; WALKER 1927); no finds, however, have been made in the areas immediately to the south and southwest of Newfoundland. As regards the two species of *Armadillidium* mentioned, they are well-known inhabitants of the Mediterranean that have become largely spread by man. Very probably they will not be able to survive the winters of Newfoundland, but sporadic finds in artificial habitats are of course possible. This also holds true in respect of *Porcellio laevis*, an inhabitant of the more temperate regions of N. America (see WALKER 1927, p. 179; VAN NAME 1936, p. 270 – 280; HATCH 1947, p. 204 – 205).

4. SUMMARY.

Only three species of terrestrial Isopod *Crustacea* (*Oniscoidea*) were formerly known from Newfoundland. On the basis of a collection made in the summer of 1949, the number of species has become increased to 12, viz.: *Trichoniscus pusillus pusillus*, *T. provisorius*, *T. pygmaeus*, *Trichoniscoides sarsi*, *Hyloniscus riparius*, *Androniscus dentiger*, *Haplophthalmus danicus*, *Oniscus asellus*, *Porcellio scaber*, *P. dilatatus*, *Trachelipus rathkei*, and *Cylisticus convexus*. Of these species, *Trichoniscus provisorius*, *Trichoniscoides sarsi*, and *Hyloniscus riparius* were reported from N. America for the first time. In addition, a report on the discovery of three males of the parthenogenetic species of *Trichoniscus* (*T. pusillus pusillus*) is included, these males being the first ones known from N. America. The race in question very probably is what has been called *T. demivirgo* Blake in N. America.

The fauna of terrestrial Isopods of Newfoundland does not include any endemic

American species. All species now known from the area in question appear to have become introduced by white colonists from Europe. Although being comparatively recent immigrants, some species have become well established in Newfoundland, and thus they now occur in a number of habitats where they appear to be able to survive independently of man. This holds true for three species especially (*Oniscus asellus, Porcellio scaber,* and *Trichoniscus pusillus pusillus*), but *Trichoniscus provisorius* and *Cylisticus convexus* also appear to occur in this way.

As regards the introduction of Old World species, the Avalon Peninsula with the harbour of St. John's has been the most favoured district; five out of the 12 Newfoundland species (*Trichoniscus provisorius, Trichoniscoides sarsi, Androniscus dentiger, Hyloniscus riparius,* and *Trachelipus rathkei*) have been found in this part of the island only.

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SUOMENKIELINEN SELOSTUS.

NEWFOUNDLANDIN MAASIIROJA KOSKEVIA TUTKIMUKSIA.

Newfoundland'in saarelta tunnettiin aikaisemmin 2 maasiiralajia; tässä kirjoitelmassa esitettyjen lisäysten jälkeen lajien lukumäärä on 12. Kaikki Newfoundland'in maasiiralajit ovat todennäköisesti kulkeutuneet sinne ihmisen mukana Euroopasta; osa niistä on saavuttanut niin hyvän jalansijan, että niitä voidaan pitää Newfoundlandissa täysin ihmisestä riippumattomina.

Tässä kirjoitelmassa esitetään kolmen lajin (*Trichoniscus provisorius* Racovitza, *Hyloniscus riparius* [C. L. Koch] ja *Trichoniscoides sarsi* Pat.) ensimmäiset löydöt Pohjois-Amerikasta.

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